"REVIEW OF STUDIES ADDRESSING LEAD ABATEMENT EFFECTIVENESS"

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Executive Summary

INTRODUCTION

This report is a comprehensive review of the scientific literature regarding the effectiveness of lead hazard intervention. One use of this review is to aid in assessing the potential benefits of Title X rule-making activities. In this report, a lead hazard intervention is defined as any non-medical activity that seeks to prevent a child from being exposed to the lead in his or her surrounding environment. An intervention, therefore, may range from the in-home education of parents regarding the dangers of a young child's hand-to-mouth activity to the abatement of lead-based paint. Interventions include activities that attempt to remove or isolate a source of lead exposure, as well as activities that attempt to reduce a child's lead exposure by modifying parental or child behavior patterns.

A number of studies have examined the effectiveness of abating the environment of lead hazards associated with lead-based paint, elevated dust leads, and elevated soil lead. These studies have emphasized hand-to-mouth activity as the primary pathway of childhood lead exposure and utilized interventions that targeted this pathway. Generally, they have assessed whether a particular intervention strategy effectively lowered an affected child's body-lead burden or the levels of lead in his or her environment. Sixteen such studies are summarized in this report. In total, these studies spanned 13 years, from 1981 to 1994. In all 16 cases, the interventions targeted primarily the child's residential environment. Also, the studied interventions principally sought “secondary” rather than “primary” prevention (e.g., assessing the effectiveness of lead hazard intervention on already exposed rather than unexposed children). Ten of the 16 studies focused on the abatement of lead-based paint as a primary form of intervention, five studies focused on dust or educational intervention, and one study focused on soil abatement.

It is often infeasible to directly assess health benefits following an intervention because many such benefits are subtle and, as such, are complicated and costly to measure directly. In this report, therefore, the blood-lead concentrations of exposed children are utilized as the primary measure of intervention efficacy. Blood-lead concentration can serve as a good surrogate health endpoint due to the established association between elevated blood-lead levels and adverse health effects.

MAJOR FINDINGS

The literature is very limited in its extent. However, it does indicate that blood-lead concentrations declined after lead hazard intervention, at least for children with blood-lead levels above 20 µg/dL.

The available literature only covers some of the intervention types and methods used in practice. However, declines on the order of 18-34% were measured in exposed children's blood-lead levels 6 to 12 months following a variety of intervention strategies. The evidence for blood-lead concentration declines after intervention among children with pre-intervention levels less than 20 µg/dL is mixed. With respect to changes in dust lead levels after intervention, dust lead level declines following intervention were larger than the blood lead declines. However, dust levels are of limited relevance as a measure of actual exposure or health effects.

Four of the identified studies also simultaneously traced changes in blood-lead concentration among a population of children not receiving the studied intervention strategy. The effect of their interventions may then be estimated as the difference in the decline recorded for the study population and that for the "control" population. The four studies examined distinct intervention strategies: the abatement of damaged lead-based paint, the abatement of soil at elevated lead levels, regular dust control measures, and in-home educational outreach efforts. Using this measure, these four studies each would estimate the effect of their intervention to be approximately 15%. That is, those receiving the intervention were better off than those receiving partial or no interventions.

The evidence clearly indicates that short-term increases in exposed children's blood-lead concentrations may result when abatements are performed improperly.

Declines in blood-lead concentrations followed several removal methods, as well as some encapsulation and enclosure methods. In contrast, dry scraping and sanding without HEPA vacuum attachments as well as open-flame burning of lead-based paint were both reported to produce considerable elevations in the blood-lead levels of exposed children.

Failure to clean up post-abatement debris was also associated with residential dust and blood lead elevations.

There is simply insufficient information available to identify a particular intervention strategy as markedly more effective than others.

Evolution in the techniques associated with lead hazard control make comparison of the effectiveness of different practices difficult. The literature cites comparable reductions in blood-lead concentration resulting from the abatement of lead-based paint, dust at elevated lead levels, and soil at elevated lead levels. Moreover, declines in blood-lead levels after in-home educational efforts were observed in the same range as the other interventions, at least up to one year following intervention. As for long term effectiveness, there is virtually no data on the effectiveness of any lead hazard intervention beyond one year following intervention.

Information is especially lacking on the effectiveness of interventions for children with blood-lead concentrations below 20 µg/dL. Also missing is data on effectiveness beyond one year after intervention and on the efficacy achieved by trying to prevent elevated blood-lead concentrations before they occur.

DISCUSSION

When considering the effectiveness of an intervention, it is important to recognize that childhood lead exposure stems from a number of media (e.g., paint, soil, interior house dust, exterior dust) across a range of environments (e.g., child’s residence, school, playground, friend’s residence). Unless an intervention targets all the sources of a child’s lead exposure, therefore, even an intervention that fully abates the targeted source will not produce a 100% decline in the child’s blood-lead concentration. If other sources of lead remain unaffected by the intervention, lead exposure may continue and the child’s blood-lead concentration may remain elevated.

Another factor, bone lead mobilization, can also cause blood-lead concentrations to remain elevated following interventions that reduce the targeted lead exposure. An intervention which reduces a child’s lead exposure results in the mobilization of bone-lead stores into the blood. The available scientific information on bone lead mobilization is minimal, but a simple model of this mobilization was constructed in an effort to assess its impact. Bone lead mobilization modelling results in this report suggest that observed declines of as little as 25% in a child’s blood-lead concentration might be possible for 6 months following an intervention which completely eliminates new lead exposure. The results also suggest that 25% declines in blood-lead concentrations which are observed at least 12 months after an intervention indicate the intervention was less than 100% effective in reducing the child’s total lead exposure. However, mobilization of bone-lead stores is another reason why prevention of lead poisoning before it ever occurs is important.

Finally, in planning future studies of lead hazard intervention effectiveness, the timing of post-intervention measurements should be carefully considered. Environmental and blood-lead measurements taken one year after intervention are usually appropriate because both seasonal variability and the effects of bone-lead mobilization are minimized. The timing of earlier measures should be based on such factors as the importance of observing transient elevations in blood-lead concentrations should they occur shortly after intervention, the importance of establishing a baseline for assessing recontamination of environmental media, and a trade-off between the effects of seasonal variability and bone-lead mobilization. Consideration should also be given to the population of children examined by future studies. There is a particular lack of information on the effectiveness of lead hazard intervention among children with blood-lead concentrations at or below 20 µg/dL. Absent too is information on effectiveness at time periods beyond one year and on the efficacy achieved by preventing elevated blood-lead concentrations before they occur. Fortunately, some on-going intervention studies are examining these populations, and should provide valuable information.